Abstract

Aim: Hip arthroplasty is a conventional and effective treatment for hip injuries, and the Wagner long-stem prosthesis is a promising candidate for solving many practical issues such as postoperative complications, life quality, medical expenses, and the demands of quick rehabilitation. This approach is highly demanding in techniques, and an adequate study to assess the outcomes is required. This study aimed to evaluate the early postoperative outcome and later results (3 months after surgery) of the long stem hip arthroplasty using a modified Hardinge approach in 7A Military Hospital to deduce useful remarks on these techniques.

Material and Methods: This study employed a prospective approach and was performed on 126 cases of long stem cementless arthroplasty using a modified Hardinge approach in 7A Military Hospital from March 2017 to June 2019. Postoperative early outcomes and results after three months were evaluated to assess the advantages and disadvantages of studied treatment. Modified Harris Hip Score was used as assessment criteria.

Results: There were 91 female patients (72.2%) and 35 males (27.8%). Unstable fractures made up 104 cases (82.5%), and the remaining (17.5%) were revision arthroplasty. The average hospital stay-in was 12 days. Ambulance resumption (4 – 7 days postoperatively) was achieved in 110/126 cases. “Good” and “very good” outcomes (three months after treatment) occurred in 85/95 cases (89.5%).

Discussion: The treatment of intertrochanteric fractures in geriatric patients required experiences. Fixation of the greater trochanter into the femur by wiring or steel cords proved to be efficient. Stem unfit, femoral proximal cracks, and shaft penetration or fracture occurred in a few cases and were discussed. Long stem arthroplasty met the demand of patients. Modified Hardinge approach was very useful in this study, similar to reports from other authors.

Conclusion: The study showed that long stem arthroplasty could be the reliable choice for osteoporotic hip replacements and unstable intertrochanteric fractures in geriatric patients, permits quick postoperative ambulance resumption and fully recovers preoperative muscular power, prevents decubitus complications related to disability and fatality. The modified Hardinge approach is convenient to perform and causes little muscular damage; hence it is useful in both complicated and straightforward hip arthroplasty, it meets the increasing demands of the patients and their relatives.

Keywords

Intertrochanteric Fractures; Hardinge Approach; Wagner Prosthesis; Revision Arthroplasty
Introduction
Hip arthroplasty or hip replacement surgery is a common and highly effective treatment for hip fracture nowadays [1, 2]. For damages surrounding the hip, short stem arthroplasty and conservative bone fusion can also guarantee good functional recovery; however, painful complications such as stem loosening or repeated fractures on femoral proximity may happen after the first surgical treatment and require revision arthroplasty with suitable implants such as the long stem prosthesis [3, 4]. Moreover, an increase in life expectancy in combination with age-related osteoporosis, which resulted in a raise of unstable intertrochanteric fractures; there were 150,000 cases of fractures annually in the U.S. and 2 million cases worldwide [5, 6]. Guaranteed life quality, quick ambulance resumption, and reduced care burden are also essential needs. Effective treatment for such injuries is therefore necessary to prevent decubitus complication, to achieve full recovery of muscular power, and satisfy the high demands which bone fusion methods are still unable to fulfill perfectly [7, 8]. The long stem Wagner hip prosthesis can solve the mentioned challenges, but the required skills and techniques are very demanding, and it is hard to apply for the patients with severe osteoporosis [9].

The two most common incision approaches in hip arthroplasty are the posterior approach introduced by Moore (1957) and the direct lateral approach modified by Hadinger (1982) [10]. Both methods have advantages and disadvantages depending on cases, and indications, such as Kristensen TB et al. (2017) preferred posterior over direct lateral approach and Jeyaramm M et al. (2019) vise versa [11]. Wagner long-stem hip replacement has been implemented in the 7A Military Hospital (Ho Chi Minh City, Viet Nam) and therefore this study was performed to evaluate its early postoperative outcome and later results (3 months after surgery) to make useful remarks for the techniques of the long stem hip arthroplasty using modified Hardinge approach.

Material and Methods

Study Design
This study employed a prospective approach and was performed on 126 patients treated with Wagner cementless long stem arthroplasty at 7A Military Hospital from March 2017 to June 2019 using the modified Hardinge approach. The treatment outcome was evaluated based on the Modified Harris Hip Score [12].

Indication and Contra-indication
Participants of this study included aged patients with loosened stem, patients with femoral proximal tumor which damaged the femoral head and neck, cases of failed bone fusions for intertrochanteric fractures, aged over 75 osteoporotic patients with unstable intertrochanteric fractures (type A2, A3.3 – A/O classification), and cases of revision arthroplasty due to repeated proximal fractures. The patients must meet the requirements ASA 1, 2, 3 of American Society of Anesthesiologists (ASA), did not have Alzheimer’s disease, and did not have pre-injury disabilities [8, 9]. The study excluded intertrochanteric fracture cases in young patients with good bone quality and narrow bone canal, stable fractures in aged patients in which bone fusion was still preferable, infection cases at the hip or in other locations, patients with pre-injury mental disabilities or physical disabilities, and patients with conditions of ASA 4 or above.

Surgical Procedures
The patient lay on the side, and the mechanical support structure was put at the pubic joint in the front and the coccyx in the back. The incision was made from 4 cm above the greater trochanter to 5 – 7 cm below the greater trochanter and could be longer when needed. Then the fascia lata and gluteal maximus were dissected to expose the gluteal medius, in turn, a third of the gluteal medius was cut at the attachment site to the greater trochanter closely approaching the periosteum and moving backward to the joint capsule, exposing the femoral head. The femoral head was removed, and the acetabulum was prepared. The femoral canal was fashioned to fit the prosthetic stem; the fashioning was done as the treated leg crossed over the other one at a perpendicular angle with an inverted foot. The Wagner long-stem prosthesis and the bipolar prostatic cup were inserted. The two trochanters and the femur were held together by reinforcing the steel cord, and the cup was fit into the acetabulum. The joint movement was examined, and hemostasis, sterilization, and drainage insertion were performed if needed. The joint capsule was closed, the gluteal medius was re-attached to the greater trochanter and the incision wound was closed. Anticoagulant (Pradaxa 75mg, 2 tablets/day) was administered postoperatively.

Ethical Declaration
The patients and relatives were well-informed about their conditions and equal treatment and were asked to take part in the study. The participation was strictly voluntary, verified by signed documents. Medicine Scientific Research Ethics Committee of the 7A Military Hospital approved this study (Number: 123/QĐ-HĐYD-BV7A, date: 29.03.2017) This study is original and is not published in other scientific journals.

Results

Ages and Sexes
The lowest, highest, and average ages were 75 years, 98 years, and 81 (1.5) years, respectively. Ninety-one patients (72.2%) were females, and thirty-five (27.8%) were males.

Time until Surgery
Thirty-seven patients (29.4%) were treated within 48 hours, 73 cases (57.9%) were treated from 48 to 72 hours after injury, ten patients (7.9%) were treated from 72 hours to less than one week after injury, and six cases (4.8%) were treated more than one week after injury. Waiting time from 48 to 72 hours occurred at high frequency (57.9%) as protein, blood, and electrolyte infusion had to be performed in most cases.

Fracture Types
Intertrochanteric fractures occurred in most cases (104 patients, 82.5%). Revision arthroplasty took place in 22 cases, including eleven stem loosening (8.7%), nine failed femoral proximity bone fusion (7.2%) and two repeated femoral proximal fractures (1.6%).

Arthroplasty Types
Most patients (100 cases, 79.4%) had bipolar long stem hemiarthroplasty, this treatment was mainly for

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intertrochanteric fractures, while total long stem arthroplasty (26 cases, 20.6%) was mainly for revision arthroplasty.

**Operation Length and Hospital Stay-In**

Operation length was from 60 to less than 90 minutes in 120 cases (95.2%) and was from 90 to less than 120 minutes in 6 cases (4.8%). The average length was 78 (15) minutes, and average stay-in was 12 days.

**Blood Transfusion**

Most patients (104 cases, 82.5%) required 250 to 750 ml of blood supplement, and 22 cases (17.5%) required more. Patients suffered from preoperative anemia.

**Early Postoperative Outcomes**

Most patients (110/126 patients, 87.3%) resumed walking early (4 – 7 days after surgery). Fourteen patients (11.1%) continued walking seven days – 3 weeks after surgery and two patients (1.6%) later than three weeks.

**Postoperative Complications**

Four patients (3.2%) had femoral cracks during stem insertion, commonly happened due to the thin cortical cortex. The issue was not severe thanks to the beforehand reinforcing steel cord. Two cases (1.6%) had penetrated the bone cortex due to femoral stem as the femoral shaft cortex was thin in the middle, probably happened during bone fashioning, and was checked by C-Arm. Shaft fractures took place in one patient (0.8%) during bone manipulation and were verified by C-Arm during operation. A screw plate fused the shaft fragments with reinforcing steel cord. Infection occurred in two cases (1.6%) with mucus and a ruptured steel cord. The patients were treated with two debridements with vacuum-assisted closure therapy (VAC) and one steel cord revision. The patient had to stay for 3-4 weeks in the hospital and were stabilized later. There were nine cases of complications (7.1%).

**Postoperative Long Term Results**

Long term monitor was performed in 95/126 patients for three months postoperatively. Sixty-five patients could walk independently; 20 patients required crutch assistance; 10 patients required wheelchairs but could walk short distances. Simple steel cord ruptures happened in six cases as the patients tended to lie on the healthy limb side and crossed the wounded limb over with caused overstretch of gluteal muscles attached to the greater trochanter. Two cases had postoperative dislocation with steel cord rupture and required hip relocation re-fixation of more magnificent trochanter attachment sites. Based on Modified Harris Hip Score, 62 patients (65.3%) acquired “very good” outcome (scored 81-91), 23 (24.2%) got “good” result (71-80), eight (8.4%) got “average” outcome (61-70) and two (2.1%) got “poor” outcome (<61). “Good” and “very good” outcomes made up 89.5% cases, a high proportion.

**Discussion**

**Indications for Long Stem Arthroplasty**

**Stem Loosening**

Eleven cases had stem loosening, eight of which had cemented stem inserted over seven years ago. Loosening of implants is a frequent complication and results in costly and technically demanding revision surgeries [13]. Loosening occurs first in the acetabulum due to aseptic bone loss. The symptoms include pain in the thigh, hip, and gluteal region and increased pain during hip movement. Patients had unusual walking and changed limb length. Radiographs show they loosened hip and deviated prosthesis. The reasons [12, 14] are due to the traumatic rupture of the implants, inadequate surgical techniques, infection, and especially aseptic bone loss at the cemented joint. Loosening frequently takes place in cemented hip and is due to electrochemical corrosion between cement and bone layers. Amongst the eleven cases observed in our study, three were due to preoperative technical issues. Based on the opinions of many authors [8, 15, 16] and our experiences, the technical problems lead to loosening are insufficient stem depth, unremoved bone, and cartilage fragments, fibrous tissues and blood, insufficient pressure during cement casting, uneven cement cast, inadequate stem fixation during congealing, undersized stem (too small compared with the canal), insufficient tightness during insertion, or inadequate fashioning.

**Defined Implant Loosening**

Defined loosened implants [10] included damaged stem (broken or disfigured), cement fractures at region IV, stem sinking at deeper than 1mm, stem outward deviation, bright zone surrounding cement-bone larger than 2 mm or is enlarging, displaced cement and prosthetic socket, deviation over than 5o, socket PE erosion, cement and socket fractures (uncommon). There are many hypotheses on the reasons [10, 17] but most authors suspected that postoperative aseptic inflammation begins with the formation of tiny fragments originating from erosion of joint or cement-bone surface (PMMA, PE), which initiates inflammation factors such as TNF, IL-1, IL-6, RANKL, OPG, PGE2. Increasing local inflammation due to an increasing amount of fragments raises the inflammation factors which activate osteoclasts cause bone loss.

**Notable Techniques and Complications for Long Stem Arthroplasty**

**Technical Recommendation**

Unstable intertrochanteric fractures in geriatric patients require treatment with stable results to achieve quick ambulant resumption, the stem must tightly fit into the femur, which is highly fragile in osteoporotic aged people hence canal fashioning and stem insertion have to be delicate and require experiences. Based on our experiences, reinforcement by twice windings of steel cord should be performed before fashioning and stem insertion as a precaution for cracking accidents. Large fragments of greater trochanter and calca are also preserved before insertion. Fixation of the greater trochanter into the femur is critical for treatment outcomes as it enables quick ambulant resumption and prevents postoperative dislocation. The fixation of the trochanter takes place after joint reduction. Under the conditions in this study, twice winding in the eight-shape from the previous shaft and calca reinforcing steel cord is very convenient; nonetheless, the risk of ruptures is high thus reinforcement by FiberWire suture (already threaded into the stem upper open) is essential. The patients should also be instructed to move gently, not to lie on the healthy limb side and cross the wounded one over to avoid overstretching of the gluteal muscles and cord rupture, thus facilitate the femoral bone fusion [9, 15, 16].
Accidents during Stem Insertion and Solutions

Stem unfit occurred once in this study. The smallest size of Wagner stem is 14, and prudent solutions for the cases of lower bone canal such as reserve stems of other types must be prepared beforehand.

Femoral proximal cracks during stem insertion happened in four cases in this study and are frequent accidents because of the thin bone cortex, hence delicate, and carefulness is necessary. This issue is not severe, though, as steel cord reinforcement is prepared beforehand.

Shaft penetration or fracture due to fashioning or stem insertion also may take place due to the thin cortex in the middle of the shaft. In this study, the reason probably was fashioning, and a C-arm examination is performed.

Advantages of Long Stem Arthroplasty for Unstable Intertrochanteric Fractures

Based on the study results, the operation length of long stem arthroplasty is no longer than traditional bone fusion. Ambulation can resume only several days postoperatively, and full preoperative muscular power was recovered. Decubitus complications like compressive lesion, pneumonia, and resurfase of chronic diseases can be avoided. Quick walking resumption is mentally beneficial for the patients and brings down the care burden for the family. Long stem arthroplasty meets the demand for increasing life quality for patients and relatives.

Remarks on Modified Hardinge Approach

We consider the modified Hardinge approach as very useful in hip arthroplasty, both simple and complicated cases. This approach is quick to perform and causes little bleeding, avoids postoperative dislocation, and enables rapid rehabilitation and a broad range of motion. For long stem arthroplasty in intertrochanteric fractures, the modified Hardinge approach is convenient for the fixation of trochanteric and calca and treatment of the bone fragments. This approach was used in the study of Harwin et al. (1990) [4], Kayali et al. (2006) [7], and Jayapalan et al. (2015) [18], and was highly praised by Petis et al. (2015) [19].

The modified Hardinge approach can risk damaging the superior gluteal nerve and the muscles [6, 20-22], but none were observed in this study.

Conclusion

Long stem arthroplasty is a reliable choice for osteoporotic revision hip replacement and unstable intertrochanteric fractures in the geriatric population. This method enables quick postoperative rehabilitation and full recovery of preoperative muscular power, and it prevents decubitus complications related to morbidity and mortality. The modified Hardinge approach is easy to perform, causes less muscular damages, and is useful for hip replacement, both complicated and straightforward cases. Thus it satisfies the needs for increasing the life quality of the patients and relatives.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Conflicts of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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